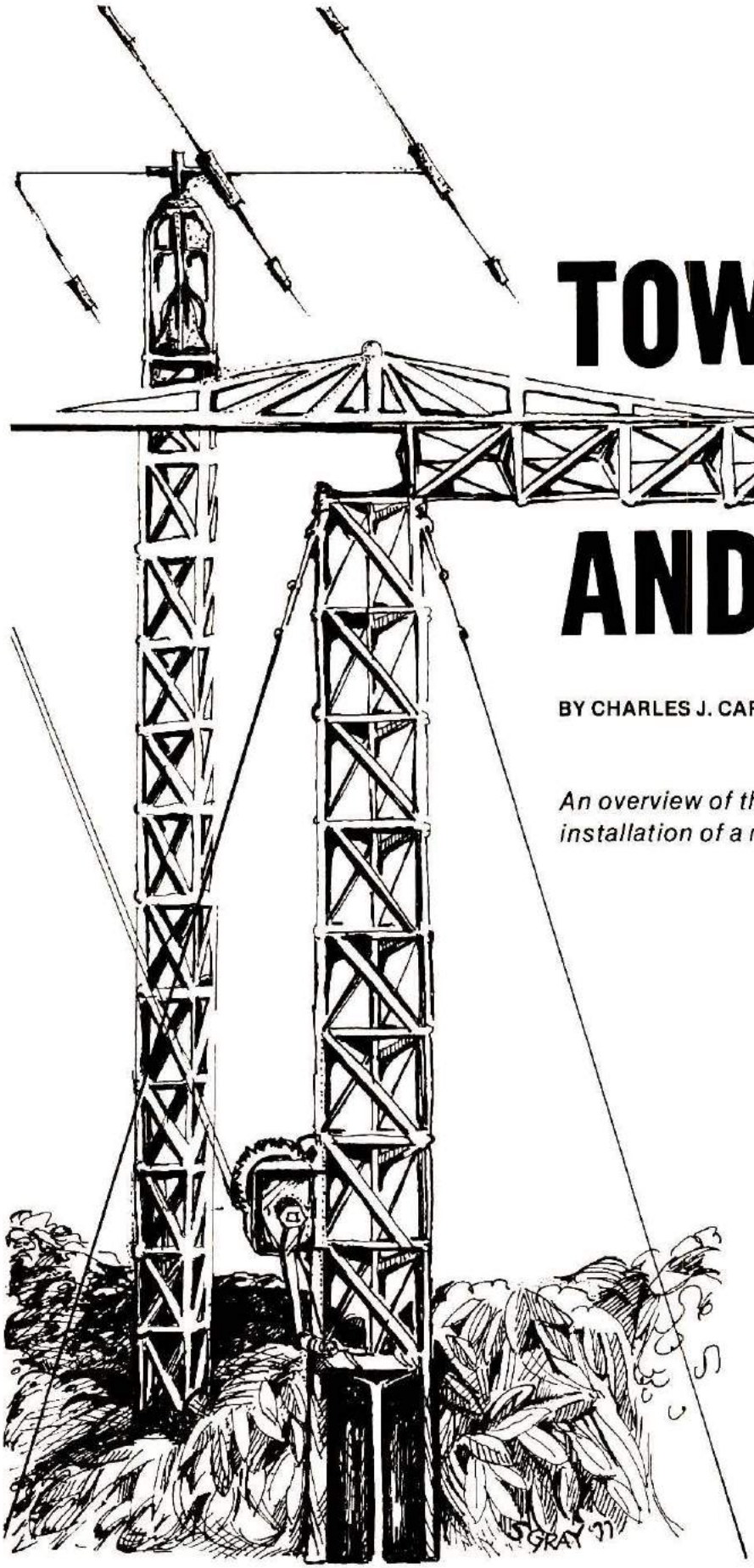


TOWERS UP AND DOWN

BY CHARLES J. CARROLL, K1XX

An overview of the selection and installation of a radio tower

Somewhere in that natural progression from Novice to General, many Amateurs look longingly to the skies, visualizing a beam and the associated tower. With the increased feeling that the old dipole is radiating poorly in all directions, some people seek ways to turn those visions into real steel and aluminum. Usually many hours are spent poring over catalogs and brochures describing the many rotary systems that can be built or purchased. Unfortunately though, an equally important part of the installation is largely overlooked — the tower. Allowable wind loading, maintenance problems, and expandability are a few of the

questions that should be considered before any tower installation is undertaken. So spend a little extra time during the selection phase, and consider what your tower will be up against in the coming years. Quite a few days have started off on a sour note when an amateur found his beautiful tower lying in a neighbor's flowerbed.

General considerations

Before laying out a large sum of money, you should look closely at the capabilities of your intended tower. How large an antenna, and with what wind loading, is generally one of the prime considerations. Height, expandability, accessibility, and cost are other factors which should be considered.

Typical specifications might rate the tower at 9 square feet (7.5m^2) of wind load at 40 mph (64km/h). This is a reasonable amount of windloading, unless a blizzard or wind storm comes through your area. A study has shown that the majority of the United States has never experienced winds greater than approximately 85 miles per hour (137 km/hr). Only isolated portions of the country will have the pleasure of experiencing the high winds of a hurricane or other storms. It's best to be sure that your tower is rated for the extreme rather than the normal loading conditions. Check that specification carefully.

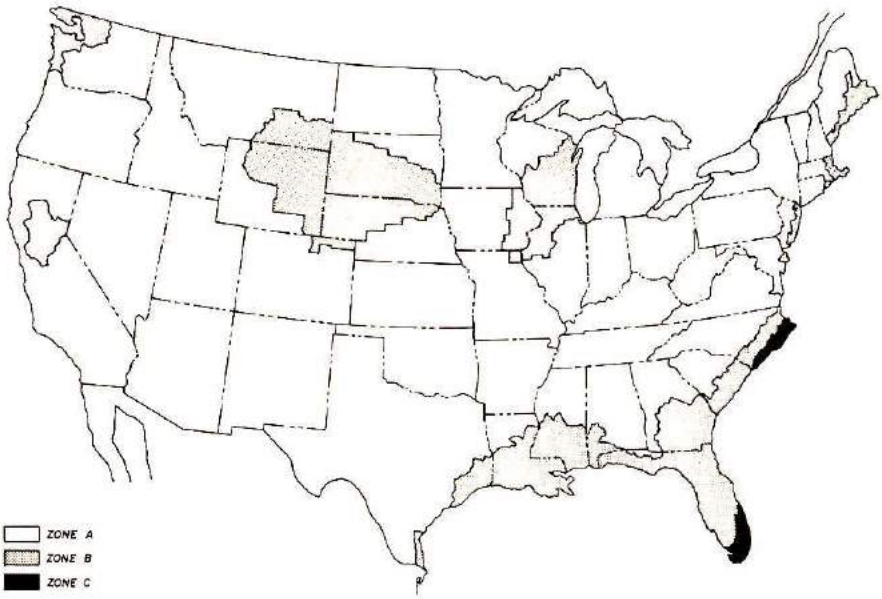


Fig. 1. Expected wind loading areas of the United States from EIA Standard RS-222-B. Zone **A** includes wind velocities to 86.6 mph (139.5 km/h) or 30 pounds per square foot (1.44 kilopascals [kPa]) of impact pressure. Zone **B** is up to 100 mph (161 km/h) or 40 pounds per square foot (1.92 kPa). Zone **C** is rated at 111.8 mph (180 km/h) or 50 pounds per square foot (2.39 kPa). This information is for towers which are less than 300 feet (91m) high.

"I'll go over in a couple of days and see how the beam held up . . ."

Crank-ups

For those people who prefer to do their antenna work with one foot on the ground, the crank-up tower is very popular. Many models are available, ranging from those with small tubular sections to some with large triangular or square sections, each portion telescoping into the next lower one. Though presenting a definite convenience, the crank-up has some limitations. The maximum height cannot be increased, for example. Once a tower of a specific size has been purchased, that is as far as it will go. However, it may be used at less than maximum height if needed. Furthermore, the crank-up models are usually not capable of supporting the large arrays that are more commonly found installed on a sectional type tower. Some companies do have versions that will support large rotary antennas although the price is certainly commensurate with their size.

One very important item surfaces when you use a crank-up tower. Safety is a prime consideration when working near *any* tower, but the hazards increase when using a crank-up. Many stories have been told of people being injured while moving or working on the tower. Unless locks are installed when the tower is extended, the weight of the sections is supported by the winch and cable. A defective cable, poorly maintained winch, or even plain carelessness, can result in a sudden and unexpected lowering of the tower. For anyone standing on a section, the results will be immediately obvious. Crank-up towers have their place, but exercise caution and good judgement when you work on them.

Even though a crank-up tower is usually self-supporting, it can be guyed for additional strength. This is an added measure of safety that may save the tower during an unexpected storm. The relatively small amount of money spent on guying will result in more peaceful sleep at night.

An installed guy anchor prior to attaching the turnbuckles. Each tower will have different anchor requirements. This particular guy anchor is buried approximately four feet (1.2m) into concrete.

Sectional towers

Probably the most versatile is the sectional tower. This type of tower uses identical sections, generally 10 feet (3m) long, that are joined together as the tower is erected. One immediate disadvantage should be apparent: You can't do all your antenna work on the ground! Generally though, once the tower is properly completed, it will survive even the worst of storms. One of the nice advantages of the sectional tower is that it can be increased in height. Raising the height of an antenna from 60 to 120 feet (18 to 36m) only requires the acquisition of 6 more sections, not a complete new tower. Another feature of this tower is that the sections are sometimes light enough that a single person can assemble a complete tower. This may entail tremendous amounts of work and energy for a lone person, but it can be done. The Rohn 25G series (40 pounds or 18kg per section) tower lends itself nicely to this type of installation for those isolated areas like New Hampshire. It's when assembling the larger Rohn 45 (70 pounds or 32kg per section) that the task becomes difficult.

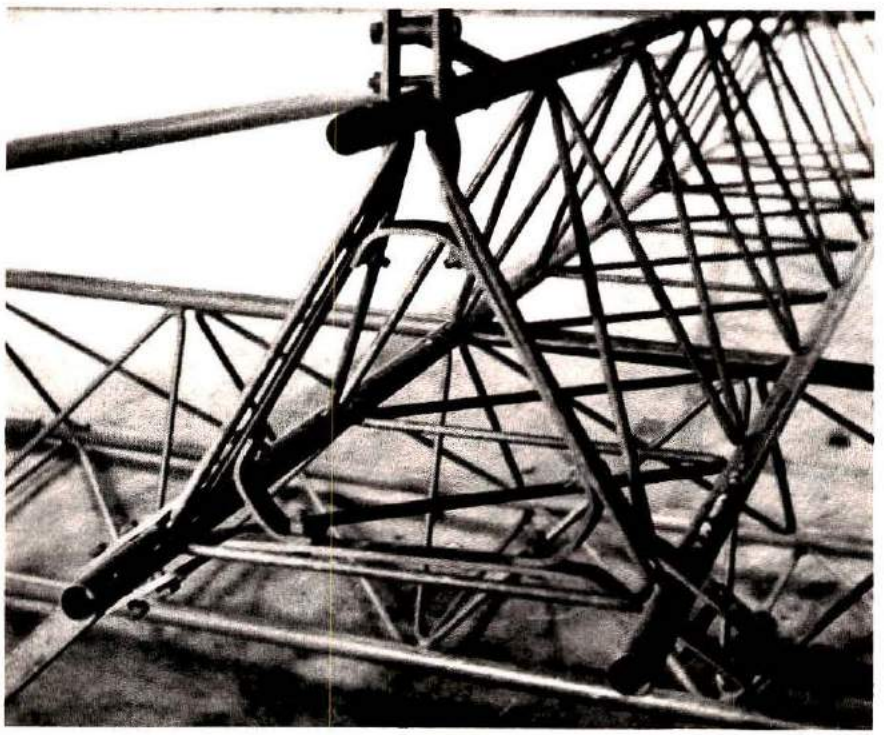
In case you might be wondering about the difficulties of placing an antenna at the top of a non-crank-up tower, rest assured that it can be done. With a little patience even the largest array can be threaded through the guy wires and installed at the top. If this approach is not satisfactory, the antenna can be taken up in pieces and then assembled at the top. Some ingenious people have even made use of the guy wires as a trolley system for raising an array.

Safety

The most important item to consider, for any tower, is safety. Use a lot of good, common sense and judgment, backed up by sound engineering. More and more reports are showing up in the newspapers which talk about people who were electrocuted while installing an antenna and/or tower. Make sure that any erected tower can not fall across nearby power lines. Ground safety is another consideration. Those people who are providing ground support for others on a tower must be conscious of what is occurring. Just being the "strong back and weak mind" is not enough. Thinking is required of everyone. Any object dropped from a tower can instantly become a lethal weapon. So stay away from the base of a tower and, if possible, wear a hard hat at all times. It may seem like a belabored point, but the consequences are very real, especially if you've seen them first hand. Though crank-ups were previously mentioned, the subject is very important; exercise extreme caution when when working with a crank-up tower.

As with most items today, the final selection of a tower largely depends on the size of your pocketbook. A few tips are in order to help defray some of the expenses. Sometimes towers can be obtained by the "take it down and it's yours" routine. Companies or individuals may want a tower removed and very often will let you have the tower simply for removing it. This frequently occurs in areas where a CATV system is being built. Check

Shown are torque bars installed on the tower sections. With guy wires attached to the torque bars, the tower is prevented from twisting either in the wind or as the rotator turns a beam.



with a local tower or antenna company; occasionally they have removed a tower and may be trying to sell it. Surplus or scrap-metal companies may have towers that are available at a reasonable price. With modern galvanizing techniques, it is possible to find older towers in very good condition.

Quite by accident, I discovered that the company doing a local CATV installation was using ¼-inch (6.5mm) EHS (extra high strength) galvanized guy wire for their stringer cable. Any time they didn't have enough cable to reach the next pole, the short portion of cable was discarded as scrap. The thought of the many thousands of feet being discarded still makes me sick. Check with any local CATV companies, their "scrap" is your gold. A typical tower installation would use 3/16 inch (5mm) EHS, so the ¼-inch (6.5mm) size is a little added safety factor.

In the rural areas of the country your local power company may be willing to sell you insulators or guy anchors. As you get nearer the cities, this attitude seems to disappear. At times, some very high-quality materials can be obtained for very reasonable prices.

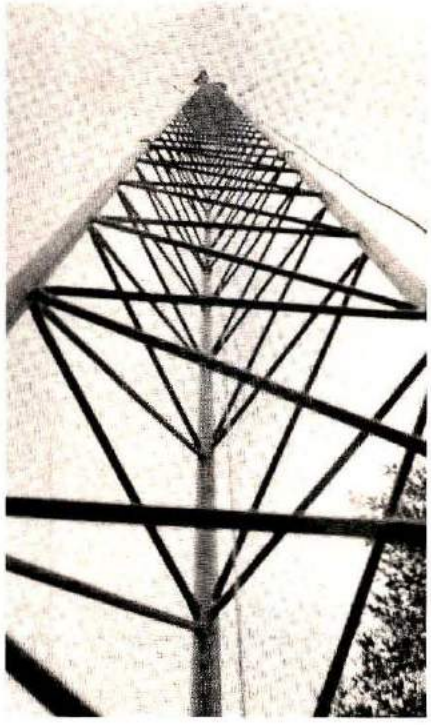
Regardless of the type of tower you choose, some form of maintenance must be done. The aluminum tower has become quite popular because it is relatively maintenance free. This, though, does not relieve you of all worries. Water can collect inside the legs, later freezing and splitting a leg. Generally, galvanized towers are rust free. A yearly check will show any areas that have broken down and begun to rust. If bolts are used to join the sections together, they should also be a non-rusting type (stainless steel or cadmium-plated steel). If not, some type of preservative should be applied before and after installation. Every few years the bolts may have to be replaced due to rusting of that portion of the bolt which is inside the tower leg. For the crank-up tower, the winch and hoisting cable must be flawlessly maintained. Also, the tower may require lubrication on the travel surfaces.

Installation

With a tower selected, the next major problem will be the installation. Many local ordinances have been enacted that will limit the height or restrict the final site, so if the tower falls, it must fall on your own property. With a quarter-acre lot and such a stipulation you're very restricted as to height and location. Therefore, adequate preparation must be done beforehand to prevent an unhappy visit from the building inspector. If the tower is going to be used to support any type of non-rotating, directive array for the lower frequencies, consideration should be given to the direction of the tower faces, prior to installation.

After making the final decisions about installation,

From the bottom looking up. This tower is 120 feet (37m) of Rohn 45 that is installed at the author's QTH in New Hampshire. You can see one of the guy wires being pulled up for installation.



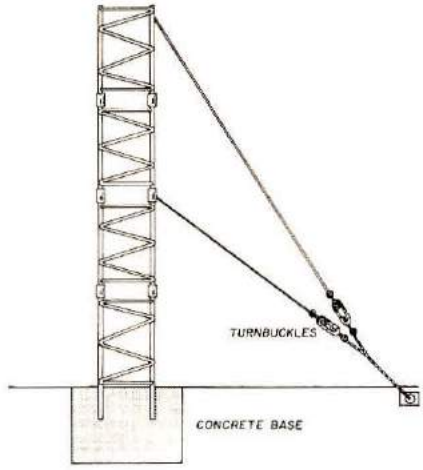


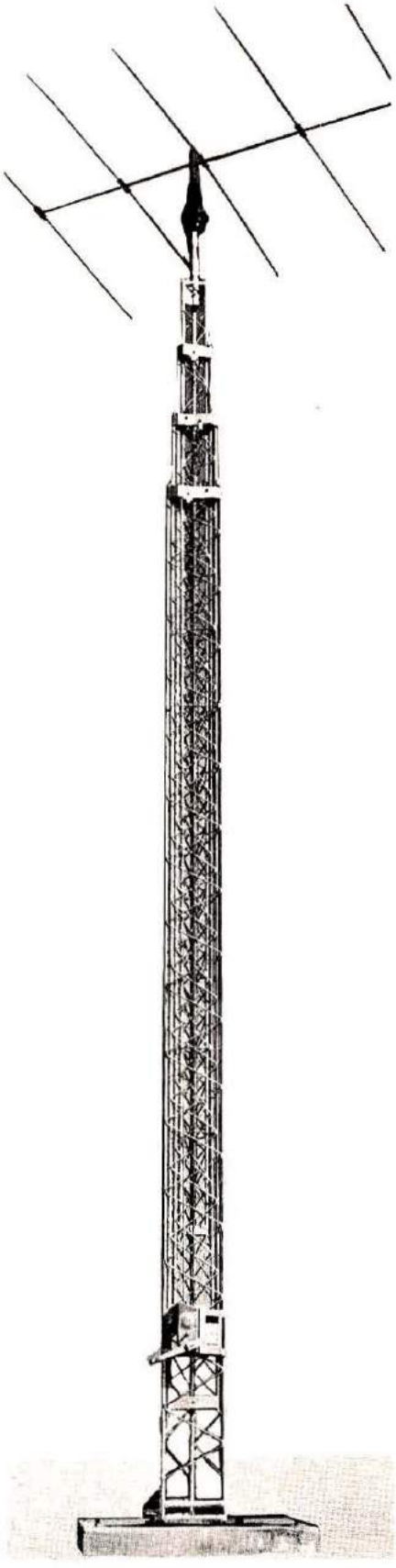
Fig. 2. A typical installation for a sectional tower. The distance from the base of the tower to the guy point should be 80 per cent of the final tower height. The top guy wire may be used to form a trolley system that will allow a large beam to be brought up in a single piece. The amount of concrete in the base is given in the manufacturers specifications.

the actual labor can be started. Most towers are supplied with instructions that dictate the type and size of base support. Generally speaking, concrete is poured around a separate base section. It's imperative that the base section be vertical and some method must be used to ensure that it has been set up correctly when the concrete is poured into the hole. With the sectional tower, the first section can be attached and then trued up. For crank-ups, it may be a long process of pouring the concrete and continually checking vertical alignment.

With a properly installed base section, most of the major work is completed for the crank-up tower. If not already done, the hoisting cable must be strung in the tower and the winch attached. At this point the tower can be attached to the base and raised to the vertical. Now a convenient support will enable the attachment of rotor, antenna, and any other hardware. Before installing the antenna, it's a good idea to run the tower up and down several times to make sure everything is working the way it should.

After the concrete at the base section has had time to properly cure, the installation of a sectional tower can begin. The general procedure calls for the people on the tower to guide the joining of the sections while those on the ground provide the heavy work. As each section is installed, the tower workers move upward and make preparations for the next section. When installing a sectional tower, the use of an erection fixture (gin pole) will speed up the process. After each section is installed, the gin pole is moved and used to bring up the next section. It's advisable to check the alignment and even join the sections on the ground. Occasionally drops of the zinc compound used for galvanizing will form on the inside of the legs; their removal will ease the installation. Another tip is to apply a little anti-seize compound on the legs prior to installation. It will not only make the legs go together easier but if extensive assembly or disassembly is anticipated, they will also come apart with little effort.

After a certain amount of tower is erected, a set of guy wires is attached. The spacing between the guys will depend upon the type of tower and installation. Generally it varies from 30 to 40 feet (9-12m) separation. Though not mentioned specifically, the installation of guy anchors is another important point. The anchors will have to bear the stress imposed by the guy wires without pulling from the ground. A typical tower will have the guy points located approximately 80 per cent of the tower's height from the base. Turnbuckles can be used to take up the slack in the guy wire, buy only after the proper tensioning has been done. It is generally thought that the turnbuckles perform the tensioning, but this is not the case. A cable grip is used to hold the guy wire in tension while the cable clamps are installed. The turnbuckle is then used to take up the slack before releasing the cable grip. As the tower is being erected the guy wires are used to make sure the tower remains perfectly vertical. After the installation has been completed and the guys have been properly tensioned, the turnbuckles should be locked in some manner to prevent them from turning and loosening up.



The typical crank-up tower, such as this one by Tri-Ex Tower Corporation, may consist of three or four telescoping sections. Your installation can be strengthened by the use of a house guying bracket for the bottom section.

Conclusion

Throughout this article I've tried to speak only in generalities. The final installation of any tower is dictated by your own requirements. Commercial towers might require the tensioning of each guy wire to 1100 pounds (500kg) and the use of three cable clamps per wire, plus serving the wire ends. However, tower cost may become prohibitive if all the commercial standards are followed; you must judge to what degree your tower will be installed. Excellent results have been obtained in amateur installations using only a portion of the commercial standards. One source of good information is the *Rohn Communications Catalog*. In addition to giving all the specifications for their towers, the book contains some very good engineering information for tower installation.

A very good tower can be obtained and installed for a reasonable price. Don't try to shorten the installation for the sake of a few dollars; use a smaller tower instead. For those unlucky few who do lose a tower in a storm, they'll find that in most cases it is covered in their homeowner's insurance policy. If not, and also for the people who have kind landlords, the additional coverage can be obtained at a very modest price. Locally, the quoted rate is about 50 cents for each 100 dollars of value; certainly a worthwhile investment. **HRH**